NEOTROPICAL BIOLOGY AND CONSERVATION

Neotropical Biology and Conservation 20(3): 247–254 (2025)
DOI: 10.3897/neotropical.20.e159659

Short Communication

Records of *Polycladus gayi* (Tricladida, Geoplanidae) preying on the invasive slug *Limax maximus* (Gastropoda, Limacidae) in Chile's temperate forests

Rodrigo M. Barahona-Segovia[1], Eduardo Quintanilla Iturra[2], Camila Meneses Rubio[3], Pablo Silva-Reyes[4], Leonardo Hormazábal[5]

1 *Present address: Laboratorio de Ecología y Conservación de Invertebrados (LECI), Departamento de Ciencias Biológicas y Biodiversidad, Universidad de Los Lagos, av. Fuchslöcher 1305, Osorno, Chile*
2 *Red de observadores de Aves y Vida silvestre de Chile (ROC), Julio Prado 1144, Santiago, Chile*
3 *Río Maule 4045, Valdivia, Chile*
4 *Facultad de Ciencias Forestales y Recursos Naturales, Universidad Austral de Chile, Isla Teja s/n, Valdivia, Chile*
5 *Centro de Humedales Rio Cruces, Universidad Austral de Chile, camino Cabo Blanco Alto s/n, Valdivia, Chile*
Corresponding author: Rodrigo M. Barahona-Segovia (rodrigo.barahona@ulagos.cl, rbarahona13@gmail.com)

Abstract

Terrestrial planarians are important soil predators of a variety of invertebrate groups, including exotic and invasive mollusc species. However, data on prey in natural conditions are scarce. *Polycladus gayi* is a giant planarian from the forests of southern Chile whose predatory behaviour is poorly known. Here, we report two cases of predation on *Limax maximus*, an invasive slug recorded within native forests. We suggest that *P. gayi* displayed two distinct types of predatory behaviour: (1) helicoidal tube formation and (2) surrounding immobilisation. As the reported distributions of the invasive slug and *P. gayi* are similar, we suggest this predator-prey interaction might be common. Furthermore, depending on the prey type and size, *P. gayi* might exhibit different types of predatory behaviour. This knowledge reveals little-known aspects of *P. gayi* ecology, raising new questions about ecological and conservation issues.

Key words: Land planarian, native forest, Platyhelminthes, predatory behaviour

OPEN ACCESS

Academic editor: Piter Boll
Received: 21 May 2025
Accepted: 7 July 2025
Published: 29 August 2025

ZooBank: https://zoobank.org/D10AFBB9-5CFC-4CF9-80DD-96D4CFE98680

Citation: Barahona-Segovia RM, Quintanilla Iturra E, Meneses Rubio C, Silva-Reyes P, Hormazábal L (2025) Records of *Polycladus gayi* (Tricladida, Geoplanidae) preying on the invasive slug *Limax maximus* (Gastropoda, Limacidae) in Chile's temperate forests. Neotropical Biology and Conservation 20(3): 247–254. https://doi.org/10.3897/neotropical.20.e159659

Copyright: ©
Rodrigo M. Barahona-Segovia et al.
This is an open access article distributed under terms of the Creative Commons Attribution License (Attribution 4.0 International – CC BY 4.0).

Introduction

Land planarians are key predators of the forest floor, preying on terrestrial isopods, native and exotic snails and slugs, earthworms, insects, springtails, mites, spiders, and other flatworms (Froehlich 1955; Ogren 1995; Fiore et al. 2004; Prasniski and Leal-Zanchet 2009; Boll and Leal-Zanchet 2015, 2016; Boll et al. 2015; Cuevas-Caballé et al. 2019; Cardoso et al. 2023). Some land planarians detect their potential prey through chemical cues, while other species ambush their prey as they patrol the habitat (Iwai et al. 2010; Boll and Leal-Zanchet 2015, 2018a). Land planarians display several strategies to attack their prey after exploring the habitat, including surrounding, covering and entrapping immobilisation, shell climbing for snails or helicoidal tube formation for slugs (Boll and Leal-Zanchet 2018b). Much of the natural interactions between land planarians and their prey

have been found through laboratory experiments (Sugiura 2010; Boll and Leal-Zanchet 2018a, b; Noël et al. 2025); however, other methods, such as citizen science, have gained popularity in the last decade to obtain information about prey. For example, after European citizens collected land planarian individuals, researchers analysed their gut content to determine what they eat (Roy et al. 2022).

Polycladus gayi Blanchard, 1845 (Tricladida, Geoplanidae), also known in Spanish as 'Planaria gigante valdiviana' or 'Lengua de vaca', is a striking land planarian native from forests of southern Chile. This land planarian has a black shiny body decorated with two golden-yellow paramarginal bands and a pale-blue median line (Fig. 1). This giant land planarian — more than 15 cm long (see figures in Barahona-Segovia et al. (2020) and Boll et al. (2023)) — is mainly distributed from La Araucanía to Aysén in Chile, associated with native forest and also present in the adjacent *Nothofagus* forest in Argentina (see distribution map in Barahona-Segovia et al. (2020); Fig. 2A). Although information on the ecology of *P. gayi* ecology is scarce, we know it is a predator of native molluscs such as *Macrocyclis peruvianus* Beck, 1837 thanks to citizen science, probably using the entrapping immobilisation strategy, as Boll et al. (2023) recorded. However, other potential prey could be recorded under citizen science.

Limax maximus Linnaeus, 1758 (Gastropoda, Limacidae) is a slug native from Europe that is widely spread as an invasive species across Chile, mainly in the central and southern regions (Valdovinos 1999; Letelier and Ramos 2002; Fig. 2A). It has a brownish-grey body streaked with black spots, usually variable in size and the foot is yellowish grey (Taylor 1902). The presence of this invasive species in Chile was reported for the first time by Valdovinos (1999) and it was considered an agricultural pest. Concurrently, Valdovinos (1999) and Valdovinos et al. (2005) reported that *L. maximus* is not present inside native forests and is restricted (together with other invasive molluscs) to human-dominated

Figure 1. Morphological characteristics of *Polycladus gayi* Blanchard, 1845 in dorsal view (photo by Leonardo Hormazábal).

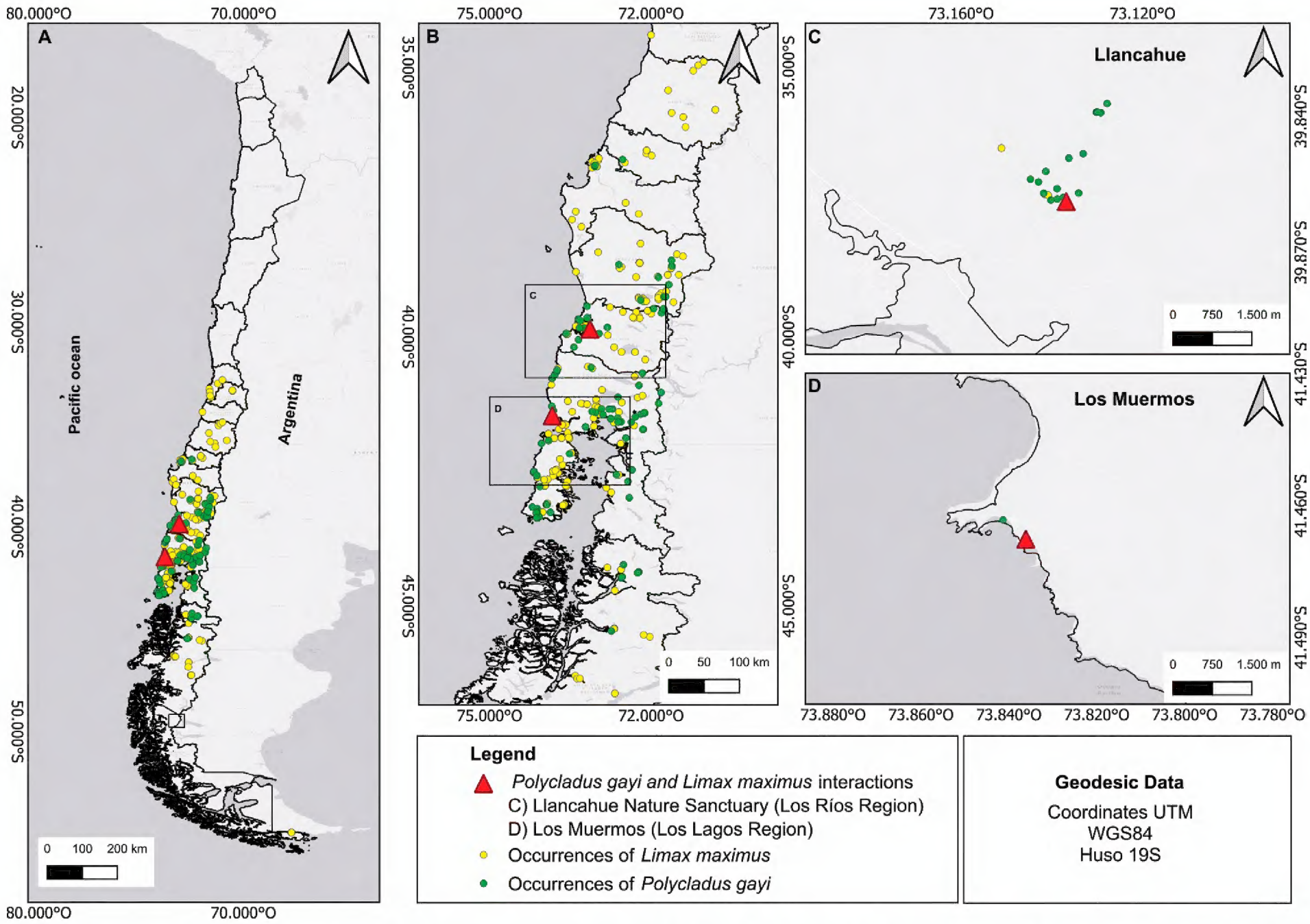

Figure 2. Joint distributions of **A.** *Polycladus gayi* Blanchard, 1845 (green dots) and *Limax maximus* Linnaeus, 1758 (yellow dots) in Chile; **B.** Detailed occurrences in southern Chile, where **C, D.** Show the exact spatial localities for both detected interactions.

environments, such as cities or agroecosystems. However, a long-term monitoring of more than 100 forest fragments detected this slug in ca. 80% of the native forest patches surveyed in central-southern Chile (R. Barahona-Segovia, unpublished data). Invasive molluscs in native forest patches could represent a threat to plants (herbaceous and with glabrous leaves; Komatsu and Saeki (2022)) and invertebrate organisms due to their voracity (e.g. Matsushima and Haga (2021)).

Since both *P. gayi* and *L. maximus* are found sharing forest ecosystems, the probability of both species interacting in a predator (planarian) and prey (slug) dynamic is high. Herein, we report and describe two records of *P. gayi* preying on *L. maximus*. We also classified the predatory behaviour of *P. gayi* on *L. maximus* using the interactions types between terrestrial planarians and their prey reported by Boll and Leal-Zanchet (2018b).

Methods

Opportunistic records were obtained from two different naturalist trails walked in the Llancahue Nature Sanctuary in Los Ríos Region on 4 May 2025 (39°51'31.572"S, 73°08'12.552"W; Fig. 2A) and 'Los Muermos' in Los Lagos Region on 5 March 2025 (41°28'3.220"S, 73°50'10.007"W; Fig. 2B). The trails have a minimum length of 500 m (i.e. Los Muermos) and a maximum of 15 km (i.e. Llancahue). The native forest in Llancahue Nature Sanctuary was dominated by

Nothofagus spp, *Eucryphia cordifolia* Cav., *Aextoxicum punctatum* Ruiz et Pav. and *Amomyrtus meli* (Phil.) D. Legrand & Kausel, while, in Los Muermos, it was dominated mainly by *Chusquea* spp. and *Ae. punctatum*. Taxonomical identification of *P. gayi* and their prey, *L. maximus*, followed Blanchard (1847) and Taylor (1902), respectively. Distribution occurrence maps of *P. gayi* and *L. maximus* were created using Facebook, iNaturalist and GBIF databases and, from this latter source, we only used records with verified research grade. Visualisation of the distribution maps was done with QGIS v.3.34.13 (QGIS Development Team 2024).

Results

Polycladus gayi displayed two potential types of predation behaviour on *L. maximus*. The Llancahue's record was observed for approximately five minutes. At this time, *P. gayi* immobilised its prey using the helicoidal tube formation (defined as the formation of a tube around the prey by twisting the body as a helix; Boll and Leal-Zanchet (2018b)) to retain the prey and move it to the pharynx (Fig. 3A). In this record, it is possible to observe how *P. gayi* everts its pharynx and part of the slug is already inside the planarian, while maintaining the helicoidal position of its body (Fig. 3A). In contrast, Los Muermos's record was only observed for 150 seconds and, according to the position of the planarian over the head of the slug, we classified this behaviour as surrounding immobilisation (Fig. 3B).

Discussion

The ecology of *P. gayi* has been the subject of recent research. Notably, thanks to citizen science, Boll et al. (2023) described *Macrocyclis peruvianus* as prey for this giant land planarian for the first time. The size of *P. gayi* allows it to capture prey almost as large as itself (Boll et al. 2023). In both cases reported herein, predation was not interrupted to measure slug length; however, adult individuals of this invasive slug can reach sizes of up to 8–9 cm (R. Barahona-Segovia, unpublished data). The interactions between *P. gayi* and *L. maximus* may suggest the concept of the biotic resistance hypothesis (Elton 1958). This hypothesis posits that the richest native communities are less vulnerable to non-native species invasions, limiting their success through predation or competition (Elton 1958). Indeed, several successful examples of biotic resistance have been examined in marine (e.g. MacNeill et al. (2013)), freshwater (e.g. Simkanin et al. (2013); Cuthbert et al. (2019)) or terrestrial invertebrates (e.g. Funderburk et al. (2016); Devegili et al. (2021)). However, although our records reveal the potential of *P. gayi* as a biological control on *L. maximus*, the biotic resistance hypothesis for this planarian species must be demonstrated through experiments in which some aspect of the slug's fitness is negatively affected.

Polycladus gayi exhibits different types of predation behaviour depending on the prey type. Boll et al. (2023) presented a figure where *P. gayi*, after recognition, covers the shell's entrance of *M. peruvianus* with the anterior part where the pharynx is located, suggesting the behaviour of surrounding immobilisation. Slug predation records also suggest two distinct types of *P. gayi* behaviour (i.e. helicoidal tube formation and surrounding immobilisation). This is consistent with other species' behaviour under laboratory conditions (Boll and Leal-Zanchet 2018b). Furthermore, the same prey type can experience different types

of hunting behaviour from the same planarian species (Boll and Leal-Zanchet 2018b). Data on predatory behaviour and other potential prey, both native and exotic, could enable a laboratory prey selection experiment to be undertaken similar to Boll and Leal-Zanchet (2015, 2016, 2018b) or Noël et al. (2025).

Lastly, considering the overlapping habitats and distributions of *P. gayi* and *L. maximus* (see Fig. 2), it is possible that these predator-prey interactions reported herein are frequent, although many other studies have shown that land planarians feed on a wide range of prey, both native and invasive species (Sugiura 2010; Boll and Leal-Zanchet 2018b; Noël et al. 2025). Further research is needed to clarify the potential role of biological control of *P. gayi* on invasive slugs and other possible prey from the native forests of temperate ecosystems. These findings broaden our understanding of one of the most remarkable giant soil invertebrates in the native forests of southern Chile, raising new ecological and conservation questions.

Figure 3. Records of *Polycladus gayi* Blanchard, 1845 preying on *Limax maximus* Linnaeus, 1758: **A.** Llancahue Nature Sanctuary's record, where it is possible to suggest helicoidal tube formation behaviour by *P. gayi* to capture the slug (record by Camila Meneses Rubio); **B.** Los Muermos's record, where it is possible to observe *P. gayi* preying on the slug's head, indicating surrounding immobilisation behaviour by the land planarian (record by Eduardo Quintanilla). The white arrow and "Ph" indicate the everted pharynx with part of the slug inside.

Acknowledgements

We thank Elías Alfaro Encina for creating the distribution map of our records and our reviewers and editor (Peter Boll) for helping improve the manuscript. RMB-S also thanks the Agencia Nacional de Investigación y Desarrollo (ANID) Subvención a la Inserción Académica (SIA) and the grant ANID SIA85220045.

Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statement

No ethical statement was reported.

Use of AI

No use of AI was reported.

Funding

The corresponding author thanks Agencia Nacional de Investigación y Desarrollo (ANID) and Subvención a la Inserción Académica (SIA) and the grant ANID SIA85220045.

Author contributions

All authors contributed to the writing and review processes.

Author ORCIDs

Rodrigo M. Barahona-Segovia https://orcid.org/0000-0002-1509-2935
Pablo Silva-Reyes https://orcid.org/0000-0002-0030-259X

Data availability

All of the data that support the findings of this study are available in the main text.

References

Barahona-Segovia RM, Araya JF, Pañinao-Monsálvez L (2020) New records of the giant planarian *Polycladus gayi* Blanchard, 1845 (Platyhelminthes: Geoplanidae) with notes on its conservation biology. Zootaxa 4822(4): 595–600. https://doi.org/10.11646/zootaxa.4822.4.9

Blanchard É (1847) Recherches sur l'organisation des vers. Annales des Sciences Naturelles, Zoologie, 3e série(8): 119–149. https://doi.org(10.5962/bhl.title.51506

Boll PK, Leal-Zanchet AM (2015) Predation on invasive land gastropods by a Neotropical land planarian. Journal of Natural History 49(17–18): 983–994. https://doi.org/10.1080/00222933.2014.981312

Boll PK, Leal-Zanchet AM (2016) Preference for different prey allows the coexistence of several land planarians in areas of the Atlantic Forest. Zoology : Analysis of Complex Systems, ZACS 119(3): 162–168. https://doi.org/10.1016/j.zool.2016.04.002

Boll PK, Leal-Zanchet AM (2018a) Lazy to prey and eager to run: behaviour of a Neotropical land planarian (Platyhelminthes: Geoplanidae) in the presence of its prey

and predators. Biological Journal of the Linnean Society. Linnean Society of London 125(2): 392–400. https://doi.org/10.1093/biolinnean/bly114

Boll PK, Leal-Zanchet AM (2018b) Diversity out of simplicity: Interaction behavior of land planarians with co-occurring invertebrates. Zoology: Analysis of Complex Systems, ZACS 126: 110–118. https://doi.org/10.1016/j.zool.2017.11.005

Boll PK, Rossi I, Amaral SV, Leal-Zanchet A (2015) A taste for exotic food: Neotropical land planarians feeding on an invasive flatworm. PeerJ 3: e1307. https://doi.org/10.7717/peerj.1307

Boll PK, Lloncón Y, Almendras D (2023) Records of the land planarian *Polycladus gayi* (Tricladida, Geoplanidae) preying on black snails *Macrocyclis peruvianus* (Gastropoda, Macrocyclidae). Austral Ecology 48(8): 2239–2245. https://doi.org/10.1111/aec.13430

Cardoso JCCF, Carbayo F, Gonzaga MOO (2023) Land planarians (Platyhelminthes) also prey on web-building spiders. Neotropical Biology and Conservation 18(3): 157–162. https://doi.org/10.3897/neotropical.18.e103322

Cuevas-Caballé C, Riutort M, Álvarez-Presas M (2019) Diet assessment of two land planarian species using high-throughput sequencing data. Scientific Reports 9(1): 1–14. https://doi.org/10.1038/s41598-019-44952-3

Cuthbert RN, Callaghan A, Dick JTA (2019) A novel metric reveals biotic resistance potential and informs predictions of invasion success. Scientific Reports 9: 15314. https://doi.org/10.1038/s41598-019-51705-9

Devegili AM, Lescano MN, Gianoli E, Farji-Brener AG (2021) Evidence of indirect biotic resistance: Native ants decrease invasive plant fitness by enhancing aphid infestation. Oecologia 196(3): 607–618. https://doi.org/10.1007/s00442-021-04874-2

Elton CS (1958) The ecology of invasions by plants and animals. Methuen, London. https://doi.org/10.1007/978-1-4899-7214-9

Fiore C, Tull JL, Zehner S, Ducey PK (2004) Tracking and predation on earthworms by the invasive terrestrial planarian *Bipalium adventitium* (Tricladida, Platyhelminthes). Behavioural Processes 67(3): 327–334. https://doi.org/10.1016/j.beproc.2004.06.001

Froehlich CG (1955) On the biology of land planarians. Boletim da Faculdade de Filosofia, Ciências e Letras, Universidade de São Paulo. Zoologia 20(20): 263–272. https://doi.org/10.11606/issn.2526-3382.bffclzoologia.1955.120214

Funderburk J, Frantz G, Mellinger C, Tyler Julian K, Srivastava M (2016) Biotic resistance limits the invasiveness of the western flower thrips, *Frankliniella occidentalis* (Thysanoptera: Thripidae), in Florida. Insect Science 23(2): 175–182. https://doi.org/10.1111/1744-7917.12250

Iwai N, Sugiura S, Chiba S (2010) Prey-tracking behavior in the invasive terrestrial planarian *Platydemus manokwari* (Platyhelminthes, Tricladida). Naturwissenschaften 97: 997–1002. https://doi.org/10.1007/s00114-010-0717-4

Komatsu W, Saeki I (2022) Feeding habits of the exotic invasive slug *Limax maximus*: A basis for risk assessment of herbivory on forest and agricultural ecosystems. Management of Biological Invasions 13(4): 644–658. https://doi.org/10.3391/mbi.2022.13.4.04

Letelier S, Ramos AM (2002) Moluscos terrestres y de aguas continentales de la expedición Iniciativa Darwin (1998–1999), región de Aisén, zona austral de Chile. Boletín del Museo Nacional de Historia Natural 51: 185–195. https://doi.org/10.54830/bmnhn.v51.2002.332

MacNeill C, Dick JT, Alexander ME, Dodd JA, Ricciardi A (2013) Predators vs. alien: Differential biotic resistance to an invasive species by two resident predators. NeoBiota 19: 1–19. https://doi.org/10.3897/neobiota.19.4839

Matsushima R, Haga T (2021) Predation on the egg of *Coelostoma stultum* (Coleoptera: Hydrophilidae) by the alien species *Deroceras laeve* (Mollusca: Gastropoda: Agriolimacidae). Molluscan Research 41(3): 254–261. https://doi.org/10.1080/13235818.2021.1946895

Noël S, Fourcade Y, Roy V, Gigon A, Dupont L (2025) Experimental assessment of the predation pressure by the exotic flatworm *Obama nungara* in its introduced range. Current Zoology: zoaf025. https://doi.org/10.1093/cz/zoaf025

Ogren RE (1995) Predation behaviour of land planarians. In: Cannon LRG (Ed.) Biology of Turbellaria and some Related Flatworms. Developments in Hydrobiology, Vol. 108. Springer, Dordrecht. https://doi.org/10.1007/978-94-011-0045-8_17

Prasniski ME, Leal-Zanchet AM (2009) Predatory behavior of the land flatworm *Notogynaphallia abundans* (Platyhelminthes: Tricladida). Zoologia 26: 606–612. https://doi.org/10.1590/S1984-46702009005000011

QGIS Development Team (2024) QGIS Geographic Information System. Open Source Geospatial Foundation Project. http://qgis.org

Roy V, Ventura M, Fourcade Y, Justine JL, Gigon A, Dupont L (2022) Gut content metabarcoding and citizen science reveal the earthworm prey of the exotic terrestrial flatworm, *Obama nungara*. European Journal of Soil Biology 113: 103449. https://doi.org/10.1016/j.ejsobi.2022.103449

Simkanin C, Dower JF, Filip N, Jamieson G, Therriault TW (2013) Biotic resistance to the infiltration of natural benthic habitats: Examining the role of predation in the distribution of the invasive ascidian *Botrylloides* violaceus. Journal of Experimental Marine Biology and Ecology 439: 76–83. https://doi.org/10.1016/j.jembe.2012.10.004

Sugiura S (2010) Prey preference and gregarious attacks by the invasive flatworm *Platydemus manokwari*. Biological Invasions 12: 1499–1507. https://doi.org/10.1007/s10530-009-9562-9

Taylor JW (1902) Testacellidae. Limacidae. Ariodidae. In: Taylor JW, Roebuck DW (Eds) Monograph of the land & freshwater Mollusca of the British Isles. Leeds, Taylor Brothers, Washington DC, 34–52.

Valdovinos C (1999) Biodiversidad de moluscos chilenos: Base de datos taxonómica y distribucional. Gayana (Concepción) 63(2): 111–164.

Valdovinos C, Olmos V, Moya C (2005) Moluscos terrestres y dulceacuícolas de la cordillera de La Costa chilena. In: Smith-Ramírez C, Armesto JJ, Valdovinos C (Eds) Historia, Biodiversidad y Ecología de los Bosques Costeros de Chile. Editorial Universitaria, Santiago de Chile, 292–306.